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POPULAR EDUCATION IN GERMANY AND IN ENGLAND.

STUDY OF GEOGRAPHY—VALUE AND USE OF MAPS.

[German Itinerant Map-Seller.]

WE wish we could have given an "English" itinerant map-seller in our cut, but it will be long, we fear, before such a character will be found amongst us as the representative of a class. At present a travelling dealer in maps would find small encouragement in our hamlets and villages, or even amongst the artisans of our great towns. A desire for maps must be created before the hawker will find it profitable to include them in his little stock. But why, it may be asked, should an occupation which has no existence in England afford a livelihood in Germany? It is true, that in England, there are in all parts of the country well-supplied shops which afford facilities for supplying every demand, while in Germany they may be fewer and more scattered; but this is not the reason why we have no travelling map-sellers, for books are sold to a great extent in England by itinerant traders, who could as easily supply maps—if there were a demand for them. Why there is no such demand may be easily discovered. In most of the German States the standard of popular education is much higher than in England, and hence the existence of a more elevated taste among the great body of the people in those states than in our own country. In many parts of England not one-half of the adult population can write their name; and in the last 'Report' of the Registrar-General a table is given showing that out of all the persons married in England and Wales in one year, there were 41 out of every 100 persons married who were incapable of signing their names to the document attesting their marriage. When an adult is unable to write, it may be safely assumed that the time he has spent at a school has been very brief; and generally speaking it is as safe to conclude that he is incapable of reading with pleasure and advantage to himself; and under these circumstances it is too much to expect

that he should be acquainted with the elements of any of the branches of knowledge; for reading is but the instrument of knowledge, and not knowledge itself.

In Germany teaching as an art has been carried to a much higher point than in England; and a most important department of German literature consists of treatises designed to impart to persons engaged in tuition not only the knowledge which should be conveyed to children, but the most rational manner of impressing it upon their minds. Books of this class are often written by men of the highest talent; they are founded upon a true knowledge of human nature; display a perfect acquaintance with the operation of the mental faculties in children; and greatly facilitate the progress of instruction. Popular education on a right basis has perhaps made greater advances in Prussia than in any other part of Germany; and it has been the peculiar care of the Prussian government to introduce improvements from time to time, and thus by degrees to elevate the standard of education to its present scale. "Reading and writing, which formerly constituted the greatest part of instruction, are at present only considered as parts of the study of the *native language*. The casting of a few simple accounts, which forty years ago was thought the height of erudition to be obtained in elementary schools, has been pursued to *mathematics*. Under the general name of *knowledge of the external world* are comprehended the first elements of geography, history, natural history, and natural philosophy: none of these objects formerly were brought before children in these schools, except in a few disjointed notices in the course of reading-books. A new subject has lately been added to this list, namely, *drawing*. The instruction in *religion* and *singing* has much increased in intrinsic value, and is likewise carried to a greater extent."*

The third subject of instruction in the Prussian elementary schools, which comprises a knowledge of the external world, includes geography. The course commences by making impressions on the *senses* of a child: *things* are taught, and not *words* merely. Correct ideas are imparted to the child of the objects which exist around him—plants, animals, and inanimate objects; the natural features of the neighbourhood—hills, valleys, and rivers, the teacher taking the children out with him and directing their attention to each class of objects, mingling with his observations on the uses of plants; the habits of animals, &c., such mental instruction as the objects may suggest. The next step is to aid the pupil in acquiring an accurate notion of the country in which he lives, beginning with his immediate neighbourhood, the district in which it is situated, the province to which it belongs, and afterwards passing to the country as a whole. Mr. Wittich's paper contains a summary of the instruction which the whole course affords, namely:—"1, a knowledge of spaces and distances, with the inequalities of the surface occurring in them; 2, a knowledge of rocks, kinds of earth, and everything that constitutes its soil and contributes to its fertility, as climate, exposure to certain points of the compass, &c.; 3, a knowledge of the cultivated grains and plants, and also of those in a wild state which occur most frequently or have some use in domestic economy; 4, a similar knowledge of domestic and wild animals; 5, a knowledge of the inhabitants, their trades and occupations, their intercourse and religious creed; 6, a knowledge of the present political institutions and of the most remarkable historical events. Every section, therefore, contains the geography, mineralogy, botany, zoology, agriculture, technology, statistics, and history of that portion of their own country which it was the object to make known to the children."

If we compare an English village day-school with one of the Prussian elementary schools, we at once perceive the immense superiority of the latter. In the former scarcely any attempt is made to direct the attention of the children to the utility, beauty, or grandeur of external objects, and almost as little is done towards expanding their ideas or elevating their taste. Need we wonder if in after-life the parish becomes their little world, and that they are incapable of carrying their ideas beyond its limits. We now see that it is the more extensive diffusion of intelligence amongst the great body of the people which renders the occupation of the itinerant map-seller a profitable one in Germany.

It is much to be regretted that a knowledge of the principal facts in geography especially should be confined to a comparatively small number of persons in England. The native of central Germany lives several hundred miles distant from the ocean, while even the most inland parts of our island are at no great distance from the coast, from which ships are constantly sailing to every part of the globe. One would expect to find geography a subject of universal interest in a country which has been foremost in the work of discovery and colonization, and whose influence is felt over such a vast extent of the earth's surface,—but unhappily it is far otherwise. Mr. Hickson states, in his Report 'On the Condition of the Hand-loom Weavers,' that it is partly owing to the want of information concerning the great fields of enterprise in different parts of the world that men endure severe distress at home, and are incapable of appreciating the more hopeful prospects which present themselves in other countries under the British dominion. But even if these stimuli to the cultivation of geography as a branch of popular education had no existence, it is a science to which attention should be devoted for the sake of the varied and enlarged ideas which it unfolds; and there seems no reason why its most striking and useful parts should not be taught in every village school.

One thing is indispensable to the study of geography, and that is good maps. They teach *things*. "Words," says Mr. Greenough, in his last annual address to the Geographical Society of London, "words following words in long succession, however ably selected those words may be, can never convey so distinct an idea of the visible forms of the earth as the first glance of a good map. Of all contrivances hitherto devised for the benefit of geography, this is the most effective. In the extent and variety of its resources, in rapidity of utterance, in the copiousness and completeness of the information it communicates, in precision, conciseness, perspicuity, in the hold it has upon the memory, in vividness of imagery and power of expression, in convenience of reference, in portability, in the happy combination of so many and such useful qualities a map has no rival." We hope to see the time when a demand will arise for a series of maps, each exhibiting some distinct feature of the same portion of the earth. For example, our own island might be represented, first, with a bare coast outline and the courses of the rivers; secondly, another map with the high ground and the rivers also; next, a map of roads with all the great towns indicated and all the seats of manufacturing industry; and other maps might be suggested.* In consequence of the costliness of maps, the demand for them is much less active than it would otherwise be, and consequently it does not represent the extent of the latent desire which exists for such things. The application of the process of colour-printing to maps will, however, lessen the cost of production without impairing their beauty and clearness. In the 'Illuminated Maps,' the extent and configuration of each country are rendered palpable to the eye by the distinctness and uniformity of the colouring, and as the mountains may be defined in white tints, they can be accurately laid down without interfering with the names of places which lie at their base or are

* 'On the Former and Present Condition of the Elementary Schools in Prussia.' By W. Wittich, Esq. First Publication of the Central Society of Education, London, 1837.

* See a valuable paper on the 'Study of Geography,' in No. 13, 'Journal of Education.'

situated upon their slopes, an advantage of great value where the maps are on a small scale. The adaptation of the process to the production of a greater variety of cheap school maps will, it may be hoped, both encourage and supply a demand for such articles, and contribute to extend the study of geography and to facilitate its introduction as a department of popular education.

We will conclude this long notice with an extract from a valuable little work by a lady who has exerted herself with much zeal to promote the practice of an enlightened system of education. Writiug on the subject of geography, she shows how a *commencement* may be made in learning the *use* of a map:* "Ask the steward to lend you the farm map: all the fields and cottages around the school are marked out on it; so are the orchards, the Cot field, the Wetcott, and the higher and lower Burn side. Now after they have made out and can tell you the direction in which all these places lie, the shape, and, as near as they can guess, the size of the fields and orchards, do you take this map and lay it on the table, and allow the elder boys to look at it with you. They will themselves find out the different hamlets, which are all marked on the map, as well as every nook and corner they know so well. Now, after they have looked over this map, they will have some notion of what a map means; but they will not at once take in what is meant by a map of the world. The view from Manor Hall knoll appears to them to take in the whole world. I advise you to take another evening's walk to this high spot, and tell them to look to the north, and fancy that if they set out to travel, they would travel on, days and weeks, and get on to very cold countries and even to frozen seas. Then, turning south, talk of countries far far away in that direction, where the sun shines almost right over their heads. If you look north-west, you can tell them it was in that direction the Thompsons sailed when they went off to Canada, across the seas. If you look south-east, you can say, 'Poor Richard James sailed off that way when he was transported last summer for stealing Farmer Wilson's sheep.' By degrees they will take in that there are lands and seas stretching out in all directions to greater distances than they can easily fancy."

DOMESTIC CHEMISTRY.—No. IX.

A CUP OF TEA.

THERE are perhaps few domestic subjects which require more the enlightening aid of a little chemistry, than the art of preparing a "good cup of tea." It is curious to remark how much diversity of opinion exists on this subject among housekeepers; but as it rarely happens that the same results are obtained by diverse means, so the reader will not have failed to notice among his visits to tea-parties, the very different qualities of the beverage offered to him. As prepared by one hostess, his cup of tea revives, enlivens, and exhilarates; as prepared by another, it is mawkish and insipid, and produces no effect beyond that of quenching thirst; and yet in both cases the same quality and quantity of tea may have been employed, although the resulting beverages are so different.

In order to do justice to what we may truly call "every body's subject," let us inquire first into the chemical nature of tea, and secondly into the science of the tea-pot.

The terms "astringent" and "aromatic" are applied to two very important vegetable principles, which frequently confer wholesomeness upon our food, and mark it with certain distinguishing peculiarities. It is easier to appreciate the quality of astringency than to express it in words; it is more or less pleasant according as it is more or less intense, or qualified by the presence of substances which impart sweetness, acidity, or aroma. Many of our common fruits are slightly astringent, but the most powerful example of an astringent substance in general use is tea. Astringents are frequently given in medicine as tonics; these act by restoring or strengthening the impaired powers of the muscular fibre, imparting what is called *tone* to the system. The chemist recognises astringents by two marked and infallible characters: first, they form insoluble compounds with animal jelly; second, they blacken the salts of iron. These effects result from the presence of a substance called *tannin*, which for the most part confers astringent properties upon all vegetables in which it is found:—leather is formed by the tannin of the oak-bark uniting with the gelatin of the fresh animal skin; and black writing-ink results from the union of sulphate of iron with the tannin or tannic acid of gall-nuts. The reader may satisfy himself of the presence of tannin in tea, by adding a little solution of isinglass to an infusion of tea; a tawny precipitate will be formed, constituting in fact a species of leather. If he add a solution of sulphate of iron to the infusion of tea, he will form a sort of ink.

Besides the tannin, to which tea owes its astringency, this plant also contains extract, resin, essential oil or aroma, and lignin or woody fibre. Of these it will be sufficient here to speak of extract and aroma.

The term "extract" is somewhat vague and unsatisfactory: it is supposed to be a nutritive substance generally associated with sugar, gum, starch, and other soluble substances: indeed, the term "extractive," or "extract," which was once supposed to be a basis common to all vegetables, is now applied to all the soluble matters procured from vegetables reduced by evaporation to a pasty or solid mass. Extracts, therefore, are as various in their properties as the plants which produce them. The extract of tea includes a peculiar bitter substance or principle called *thein;* respecting the separate existence of which, however, there are yet doubts in the minds of chemists. With regard to the common mode of producing the extract from the tea, Professor Brande observes, "When tea-leaves have been exhausted by water repeatedly affused, alcohol is still capable of extracting a considerable quantity of soluble matter. The alcoholic extract, infused in boiling water, furnishes a liquid which smells and tastes strongly of tea, and which, were it not for the expense of the solvent, and the trouble attending its separation, might perhaps be profitably employed."

The aromatic or odorous principle is in most vegetables dependent on a volatile oil, which can be separated by distillation. The vegetable essential oils may not perhaps be called nutritive, but they are wholesome and agreeable on account of their stimulating properties. They have for the most part a powerful odour, and this in a most remarkable manner, not well understood, influences the taste of the substances with which they are combined. The taste of cinnamon depends upon an essential oil contained in it: if the nostrils be carefully closed, and a bit of cinnamon be chewed, it will have no more taste than a piece of dry deal; and by adopting similar means the flavour of tea is entirely lost. Chemical analysis has failed to detect the principle in tea to which its exciting property is due; but until the existence of the principle called *thein* is fully established, it will not be unsafe to suppose that the odorous principle is most likely to be concerned in it.

There is not much chemical difference between black and green teas; the former contains probably more extractive and less tannin than the latter. It has been stated that the different kinds of tea are all gathered from the same species of the tea-plant; and that various qualities are conferred upon them by different modes of preparation. (See 'Penny Mag.,' vol. ix., p. 75; and for further particulars respecting the natural and commercial history of the tea-plant, vol. i., p. 33, and vol. iv., p.

* 'Letters on Education,' by Mrs. Tuckfield Let. viii., 'On the first Use of a Map of the World.'

445.) Tea is the subject of extensive adulteration; black tea is imitated by sloe, ash, and elder leaves, rolled and twisted, and then dyed with logwood or some salt of iron. This spurious tea is not, perhaps, absolutely injurious to health: but the colouring material for imitating green tea is exceedingly dangerous; verdigris, or carbonate of copper, is the material employed, and this is a deadly poison.

With respect to the art of making tea in perfection, three things are absolutely necessary: first, good tea is sufficient quantity; second, a tea-pot made of a bright metal kept clean and well polished; third, boiling water; and by this we do not mean water that has boiled, but water that is actually boiling at the time of the affusion. We may pass over the first condition with a single remark—that in proportion as the other two conditions are carefully attended to, the quantity of the tea may be lessened without deteriorating the strength of the infusion. Our notice of the other two conditions will lead us into a few details of some interesting properties of heat.

There are many striking analogies between heat and light: they usually accompany each other, and for the most part proceed from similar sources. The intensity of the one also greatly depends upon that of the other; and they are both capable of being reflected, refracted, &c. Heat, however, is distinguished by some properties which do not pertain so strictly to light: not only does it pass from one body to another at a distance from it, by radiation, in the manner of light; but it also passes from one body to an adjoining one by the process of conduction. When two bodies of different temperatures are placed in contact, heat is conducted into the colder body, and it becomes heated; while the hotter body cools, and in a short time the temperature of both becomes the same. They do not, however, continue to be hot, unless fresh accessions of heat be communicated to them from some independent source: in a short time they both cool down to the temperature of the surrounding air. This is the general tendency of all heated bodies: the heat is liberated from them either by radiation or conduction; but the time occupied in thus cooling down is very different in different circumstances, according to the substance and texture of the heated body. Heat is conducted with great facility by dense and heavy bodies: gold and silver, for example, conduct it readily; while charcoal and wood conduct badly. When therefore we pour boiling water into a metal tea-pot, the vessel becomes exceedingly hot; so much so, that were the handle made of the same material as the vessel, we should be unable to hold it: we see therefore the reason why the handle is usually made of some slow-conducting material. When a silver tea-pot has also a silver handle, it is separated from the vessel at the points of union by two pieces of bone or ivory, which conduct heat so badly, that although the vessel itself is of the temperature of boiling water, yet the handle remains cool.

Heat is absorbed by dark porous bodies, and reflected by such as are smooth and bright. If we place some grease behind two pieces of metal, of which the opposite sides are the one bright and highly polished, and the other coated with lamp-black, and expose these two surfaces to the same degree of radiant heat, we shall find the heat will be so much absorbed by the black surface as to melt the grease behind it; whereas the heat will be reflected from the light surface, and the grease will remain unmelted. Now it is a remarkable fact, that the powers of absorbing and radiating heat are in the same substance exactly equal: those bodies which absorb heat readily are also active in discharging it; while those which are slow in absorbing, are also slow in radiating.

The reader will see how closely these details refer to the philosophy of a tea-pot, by attending to the following experiment of Sir John Leslie, to whom our knowledge of radiant heat is under so many obligations. He constructed a canister of tinned iron in the form of a cube; covered its sides with different substances, whose radiating power was to be ascertained; and then filled it with boiling water. The canister was placed opposite to a concave mirror, in the focus of which was placed a delicate thermometer. The hot water of course brought the four surfaces of the cube to the same temperature; and these being in turns presented to the mirror, the effect produced by each on the thermometer measured its radiating power. Taking lamp-black as the greatest radiator, and calling its radiating power one hundred, he found paper to be ninety-eight; resin, ninety-six; crown-glass, ninety; isinglass, seventy-five; tarnished lead, forty-five; mercury, twenty; clean lead, nineteen; polished tin, fifteen; and silver, twelve. Now when we state that the virtues of tea cannot be extracted unless by boiling water, and that time is required for the extraction, the above details will sufficiently show how necessary it is to make tea in a vessel which retains its heat. A tea-pot made of a dark glazed earthenware discharges the heat of boiling water with great rapidity, so that the temperature soon falls below that point necessary for making the infusion; whereas a silver tea-pot long retains the heat, completely extracts the virtues of the tea, and ultimately repays its original high cost. Next to silver, German silver (as it is called, although it contains not a particle of silver) is best adapted to the purpose. Britannia metal is also good; in short, the chief desideratum is a metal tea-pot kept bright; and it will be found that the finer the polish the better will be its action.

The solvent properties of water are greatly diminished by solid substances suspended in it, such as several compounds of lime, &c., which exist in hard water. These are not removed by boiling; but their injurious action may be removed by adding a minute quantity of carbonate of soda to the water or to the tea before affusion. Persons who reside in places where soft water cannot be procured, should adopt this method whether in brewing tea or beer.

We may further remark that the practice of placing a metallic tea-pot before the fire while the infusion is going on, in order to keep it warm, is bad: the metal absorbs no heat, but on the contrary, is actually cooled by the current of air which passes to the fire.

HORSE ARMOURY IN THE TOWER.—XIV.

Sir Horace Vere, 1606.

[Continued from No. 548.]

Having already given an account of the fashion of arms and armour during the reigns of Elizabeth and James, we may now bestow more attention on the characters of the personages who are represented as wearing the military costume of those periods. The first we meet with after James I. is Sir Horace Vere, habited in a plain suit of armour, of about the date of 1606. Sir Horace Vere, the brother of the more celebrated Sir Francis Vere, was born in 1565, at Kirby Hall, in the county of Essex. At the age of twenty years he accompanied his brother to the Low Countries, which at that time might with propriety be called a school for the education of all cavaliers who wished to see service; and there he greatly distinguished himself by his valour and judgment. He was present at the battle of Nieuport, in 1660; and greatly assisted his brother during the celebrated siege of Ostend, in defending the city from the attacks of the enemy, and in conducting the sorties by which their opponent was so continually annoyed. He afterwards commanded the auxiliary troops sent by James I. to the succour of the Elector Palatine; but in consequence of the inferiority of his army in number, and the want of co-operation with the troops of the Elector, he was unable effectually to assist him. It cannot be said, however, that he injured his fame by the expedition; for though

[Sir Horace Vere.]

he did not return loaded with laurels as a conqueror, he had increased his reputation as a commander by his conduct throughout the campaign, and principally by an admirable retreat, effected by his judgment and coolness, from the vigorous attack of the celebrated Spinola, who, with a much larger force, pressed rapidly upon him, and scarcely left him the means of saving himself. He, however, effected a retreat without loss, and with such prudence and judgment as to acquire for himself nearly as much renown as a victory would have procured him. When Charles I. succeeded to the throne, Sir Horace Vere was raised to the peerage under the title of Baron Tilbury. After this period he does not appear to have been much employed, and he died, May 2nd, 1635. His lady, distinguished as much for her piety as for her attainments and natural good sense, was chosen by the parliament to take charge of the youngest children of Charles I. The armour of this figure is very plain, with no ornaments, but remarkable as covering the whole person, a practice much discountenanced at that time.

The figure by the side of Sir H. Vere is marked in the catalogue as Thomas Howard, Earl of Arundel. In 1608 (the supposed date of the armour) he must have been (according to Sir Edward Walker) about twenty-two years of age, at which period of his life his favourite amusements were of an athletic and warlike character, such as tilting, running at the ring, &c. The date of his birth is uncertain; but Sir E. Walker says that he was seventeen years old when Queen Elizabeth died, which would fix it to the year 1586. The early part of his life was spent in retirement suited to the diminished resources of his family; but in 1603, soon after James's accession, he was restored to such honours as he had lost by his father's attainder, as well as to the earldom of Surrey, and to most of the baronies which had been forfeited by the attainder of his grandfather, Thomas, fourth duke of Norfolk. Soon after he came of age, he married Alathea, third daughter and coheir of Gilbert Talbot, Earl of Shrewsbury, a match of great advantage; for her two elder sisters, the Countesses of Pembroke and Kent, dying childless, the greatest part of her father's noble revenues in the end devolved on her. In 1607 he was sworn of the privy council, and soon after took his departure for France and Italy, where he imbibed that taste for the fine arts which became the ruling passion of his heart, and led to the formation of one of the most splendid collections of statues, paintings, and objects of *virtù* ever formed by a private individual. He remained abroad till the year 1611, and on his return was chosen a knight of the Garter.

Unable to endure the coarseness of James's manners, and with too high a sense of his own honour and the honour of his family to be corrupted by the favourites of the court, he kept aloof from political affairs, and was therefore no otherwise publicly employed than in the reception of ambassadors, and other dignified ceremonies which suited his rank and disposition. A circumstance recorded by historians will show what an exact idea he had of propriety in these matters, and of the respect due to the king his master. We give it in the words of Lodge: "Being appointed in the year 1620 to visit the Marquis de Cadenet, the French ambassador, at Gravesend, the Frenchman, on the Earl's arrival and departure, advanced no farther than the head of the staircase; the Earl therefore, who was to conduct him the next morning to London, would then meet him only in the street; and, on their arrival at Somerset House, would go no farther than the foot of the stairs, telling the ambassador that his gentlemen would show him to his lodgings. The king, who, though without dignity, was not wanting in pride, approved of the Earl's conduct, and the ambassador apologised."

The king, on the removal of Bacon in 1621, nominated him a commissioner for holding the great seal, and on the 29th of August, in the same year, appointed (or rather, restored) him to the place of Earl Marshal of England.

He was continued in the office of Earl Marshal by Charles I., by whom for some time he was treated with great favour, but the Earl's eldest son having privately married the Lady Elizabeth Stuart, sister of the Duke of Lennox, and related to Charles, who had designed to marry her to the Lord Lorne, heir to the Earl of Argyll, the king was greatly offended, and committed the Earl to the Tower, from whence he was only released, after an imprisonment of some months, at the instance of the parliament, whose repeated remonstrances at length compelled Charles to submit.

After the assassination of the Duke of Buckingham, with whom he had never been friends, he came again to court, and soon acquired a considerable share of favour and confidence. In 1633 he attended the king at his coronation in Scotland; and in the same year was deputed ambassador extraordinary to the States-General, and was made chief-justice of the Forests north of Trent. In 1636 he spent nine months in Germany on a diplomatic mission, and during that time expended upwards of 40,000*l.* in making additions to his library and cabinet.

After this he was employed in various offices connected with the court, and in 1641 presented a petition, supported by another from several peers of great worth and power, beseeching the king to restore him to the dukedom. Charles, however, for some unknown reasons, would favour him no further than by the grant of a patent creating him Earl of Norfolk. Soon after this he quitted England for the Continent, and after wandering slowly over most parts of France and Italy, admiring the many objects of art and antiquity preserved in the places he visited, and making many additions to his own collection, he at last settled at Padua, where he died, October 4, 1646.

Though not a man of warm passions, his friendships were steady, and his enmities, where they existed, honest and avowed. His whole life was governed by a high sense of honour, and though proud among his equals, towards his inferiors he was familiar and affable. "It cannot be denied," says Clarendon, "that he had in his person, in his aspect, and countenance, the appearance of a great man, which he preserved in his gait and motion. He wore and affected a habit very different from that of the time, such as men had only beheld in the pictures of the most considerable men, all which drew the eyes of most, and the reverence of many, towards him, as the image and representative of the primitive nobility and native gravity of the nobles when they had been most venerable; but this was only his outside, his nature and true humour being much disposed to levity." With respect to his dress and bearing, Hay, Earl of Carlisle, is stated to have once remarked, "Here comes the Earl of Arundel, in his plain stuff and trunk hose, and his beard in his teeth, that looks more like a nobleman than any of us."

ON TELEGRAPHIC COMMUNICATIONS.

[Continued from No. 505.]

Telescopic observation of signs exhibited at a distance being totally unavailable in foggy weather, or in the night, unless powerful lights be attached to the moving parts of the telegraph, many other means have been proposed for obtaining the same end, among which are *sound*, *pressure of air*, *pressure of water*, and *electrical agency*.

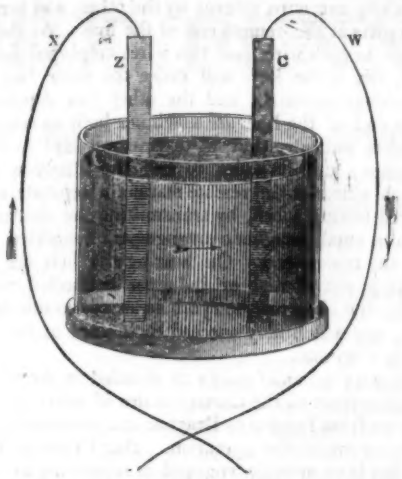
In 1828 M. Sudre proposed to the Academy of Sciences at Paris the employment of an instrument to be called the *telephony*, or musical telegraph. This was a powerful kind of trumpet or horn, capable of being heard two or three miles distant. The seven notes of the octave were to represent certain letters, figures, or words, as might be agreed upon; and the contrivance was proposed for adoption chiefly for military and naval operations. M. Sudre afterwards explained his plan in London. We do not know whether it has ever been acted on; but the public journals, about two years ago, spoke of a contrivance of M. Kfeniger, at Vienna, which consisted of a trumpet-tube six feet long, capable of yielding sounds which could be heard at a distance of 12,000 feet, and employed to convey military orders to different districts.

Within a few months a pneumatic telegraph has been proposed, and a model of one placed in the Polytechnic Exhibition, London. The principle on which it is proposed to act is this:—if a given quantity of air be confined in a tube, and be subjected to pressure at one end, that pressure will soon be felt at the other, however distant it may be. Consequently a tube of air is proposed to be used, at one end of which is a kind of collapsing bag, or reservoir. If various weights, numbered, for instance, from one to ten, be placed on this bag, they will cause various degrees of pressure, which will be felt at the other end of the tube, and may be there made to act upon the index of a dial-plate, so that the extent of the movement of the index shall denote the particular sign intended to be conveyed.

About fifteen years ago Mr. Vallance proposed the employment of a stream of water as a medium for telegraphic communication; and within two or three years a plan somewhat similar has been partially acted on by Mr. Whishaw. The principle employed is,—the well-known tendency of water to assume a common level. If water be contained in several channels communicating with each other, the *surface* of the water will be at an equal height in all. The proposal is therefore to have a pipe laid from station to station, filled with water, and terminated at each end by an upright pipe, partially filled with water. If a small quantity, say one cubic inch, of water, be poured in at one end, it will act on the whole length of water in the tube, and the water at both stations will soon be a little higher than it was before: by drawing off a little water at one station, an opposite effect will result. At each station-pipe a small float may swim on the surface of the water, and act on an index hand, as is done in some forms of the barometer. This is the theory of the hydraulic telegraph; but the difficulties that might occur in its extensive application we cannot discuss here.

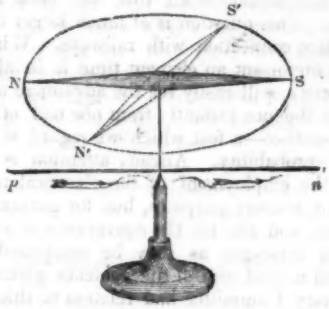
The last kind of telegraphs to which we have to allude is perhaps the most important, and is certainly the most beautiful, in a scientific point of view, of all yet proposed: we mean those worked by electrical agency. Although this is, for any useful purpose, quite a recent contrivance, yet the idea of employing common electricity as a telegraphic agent occurred long ago. Arthur Young, in his 'Travels in France,' published more than fifty years ago, after speaking of a M. Lomond, says:—"In electricity he has made a remarkable discovery. You write two or three words on a paper: he takes it with him into a room, and turns a machine enclosed in a cylindrical case, at the top of which is an electrometer, a small fine pith ball. A wire connects with a similar cylinder and electrometer in a distant apartment; and his wife, by remarking the correspondent motions of the pith balls, writes down the words they indicate, from which it appears he has formed an alphabet of motions."

But it is in our own day that the plan has been successfully adopted of applying electricity to telegraphic purposes, and in the very convenient form of galvanic electricity. The connected sciences of electricity, galvanism, and magnetism are so intricate to those who have not carefully studied them, that we cannot hope to convey much information thereon in our present narrow limits; but by attending to the following three remarks, the reader will obtain some idea of the moving-power in an electrical telegraph:—1. If a piece of copper and a piece of zinc be partially immersed in dilute sulphuric acid, a chemical action takes place; but this action is not



[This figure illustrates the *principle* of the production of a galvanic current in its simplest form. Two plates, the one of copper and the other of zinc, C, Z, dip into dilute acid. If wires connect the *dry* ends of the two plates, a current is excited in the direction of the arrows and will be continuous, whether the length of the wires be measured by inches or by miles.]

made evident, unless the upper or dry edges of the metals are connected by means of metallic wires. Directly this connection takes place, a current of the electric fluid, whatever this fluid may be, flows entirely through the wires, from plate to plate, in a continued circuit, however long the wire may be. 2. A *magnet* is a piece of steel which, either by natural or artificial means, has acquired this property—that if it be poised delicately on its centre, it will point nearly north and south. 3. If the copper,



[This figure illustrates the production of motion in a magnet by the passage of an electrical current beneath it. The magnet, N S, is poised on a pivot. A galvanic current is passing through a wire in the direction *p n*, and, by its influence, forces the magnet to assume a new direction N' S', by which a moving-power is attained, capable of being applied in many ways.]

zinc, and acid be in action in the way we have described, and which is called a *galvanic battery*, and if a magnet be poised at any distance from it, the following remarkable effect may be made to ensue:—cause a portion of the wire in its course from plate to plate to pass either over or under the magnet; the magnet will, through an unexplained action of the electricity passing through the wire, be made to point east and west instead of north and south.

These three truths, varied and extended in their application, are the foundation of the electrical telegraph. The simple principle by which this may be effected, we will thus explain:—suppose a person in London wish to convey a signal, that will be represented by the letter (A), to another person at Harrow, eleven miles distant. If he can lay down a copper wire from London to Harrow (which our railroads now enable us to do) and back again, he can make that wire part of a galvanic circle. At London there would be a small galvanic battery, and at Harrow a magnet, at a small distance round which the wire turns or coils itself. On connecting the wire with the plates in the battery, a current of electricity flows along one wire to Harrow, round the magnet, and back again to London; and, in so doing, *turns* the magnet partially round. Now there may be many contrivances by which the magnet should act as a lever, and, in its motion, open or shut a little door, or bring into view a piece of paper on which the letter A had been previously written; by which means the meaning represented by the symbol A would be conveyed from London to Harrow. As to the rapidity with which the circuit is made, we may remark, that Professor Wheatstone, from some delicate experiments made in 1834, is of opinion that electricity moves not *less* than 280,000 miles per second, a rapidity greater than that of light.

We have only made the supposition of *one* symbol or sign being conveyed from place to place. If we wish to convey as many signs as there are letters in the alphabet, we should have twenty-six wires extending from the galvanic battery to the distant station, where they would coil round twenty-six magnets; and these magnets would exhibit, by some mechanical contrivance, twenty-six different letters, any one of which could be acted on separately.

We have thus briefly shown how electro-magnetism *might* be made a telegraphic agent; and we have now to say that such a plan has been acted on in many different forms. Morse, in America; Gauss, Weber, and Steinheil, in Germany; Alexander, Davy, and Wheatstone, in England—have all constructed electro-magnetic telegraphs, differing in their details, but resembling in their main principles what we have just described.

Dr. Steinheil, in 1837, erected a telegraph at Munich, of which the following was the arrangement:—the galvanic apparatus was placed at the Royal Academy, and a copper wire extended from thence to the Royal Observatory at Bogenhausen, and back, a distance of 32,506 feet. The wire was stretched across the steeples of the city, and, at intermediate points, was supported by poles forty or fifty feet high, the greatest distance between the supports being about thirteen hundred feet. A second conducting-wire extended from the Royal Academy to Steinheil's house in Lerchenstrasse, and the length there and back was 5745 feet. The electricity was set in motion by one of the beautiful electro-magnetic machines which have been invented within a few years: all we can say of them here is, that they afford a more ready mode of effecting that which might be effected by the simple galvanic battery we described above. The electricity, in passing through the copper wire, turned or deflected a magnet; but the magnet, in so turning, did not exhibit a sign or letter previously written, but actually recorded its own movement, by imprinting on a piece of paper a series of dots, with some ink contained in a little cell at the end of the magnet. The paper passed slowly in front of the magnet, so that the closeness of the dots indicated the rapidity of the change of motion in the magnet, and was thus made the means of conveying preconcerted signals.

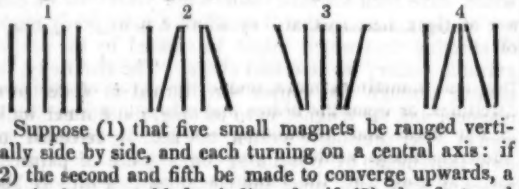
In a telegraph constructed by Mr. Alexander there were thirty wires acting on thirty magnets, about four inches long each. These magnets, when they were made to move, brought into view thirty small inscriptions, consisting of the twenty-six letters, and the comma, colon, &c. At the other end of the arrangement was a key-board, something like that of a piano-forte, containing thirty keys. On pressing down one of these keys (which were marked with the same symbols as those at the magnet-end of the machine, and each of which was joined to its own particular wire), the wire to which it was attached was brought into connection with a galvanic battery placed under the key-board. The electricity thus excited flowed through the wire connected with that key, acted on the

magnet at the other end, brought into view the desired symbol, and returned by another wire to the battery. If the letter A for instance were required, the key A would be pressed down, the wire A would become a channel for the electricity, and the inscription A would be rendered visible by the motion of the magnet. It must be borne in mind that the telegraphic power of such an arrangement as this depends on the fact, that however long the wires may be, whether yards or miles, the electricity will flow through them almost instantaneously, in order to complete the circuit.

The great object to be attained in such an arrangement is to reduce the number of wires without lessening the number of symbols or signs, and this has been done to a very important extent by improved modes of arrangement. In Alexander's telegraph, one *return* wire was made to serve for all the thirty symbols; and it has been suggested that the thirty wires might be reduced to fifteen, by making each magnet act on two symbols. In Mr. Davy's telegraph six wires are made to produce a very large number of signs, and are also made to ring a little bell, three strokes being intended to draw attention, two strokes implying the end of a sentence, and one the end of a word.

But by far the most important labours bestowed on this subject are those of Professor Wheatstone, who, in conjunction with Mr. Cooke, has made a large number of experiments, has taken out several patents for successive improvements in the machinery, and has surmounted most of the obstacles incident to such delicate scientific operations. The construction of railways offers great facilities for laying down a length of wire out of reach of harm; and in 1839 a telegraphic system was established from London to Drayton, on the Great Western Railway, as well for a trial of the apparatus, as for certain prospective advantages to the Company, should the attempt succeed. The nature of this telegraph—according to the evidence given to parliament, and contained in the Fifth Report of the Parliamentary Committee on Railways, published towards the end of the last session—is briefly as follows:—

An iron tube, laid along near the ground, contains a bundle or rope of five or six wires, each insulated from the others by a coating of cotton and India rubber, and the whole coated in a similar manner. These wires serve to convey twenty or thirty signals, by a most ingenious arrangement of magnets, which may be illustrated thus:



Suppose (1) that five small magnets be ranged vertically side by side, and each turning on a central axis: if (2) the second and fifth be made to converge upwards, a certain letter would be indicated; if (3) the first and fifth converge downwards, another letter or symbol would be expressed: if (4) the second and fourth converge upwards, a third symbol is given; and so on, two of the five wires being made to converge either upwards or downwards. Now it is easy to see that a great number of symbols may be thus expressed by the use of five wires acting on as many magnets; the magnets being made to partially rotate by an electric current passing through coils of wire behind them. The symbol expressed will depend on which wire conveys the electric agent, and which returns it to complete the circuit. The person who is to send the communication has a small machine before him connected with the battery, and provided with ten keys or plugs, by the pressure of which the electric current is communicated to the wires,—two keys to each wire. He selects those two wires which will give the requisite symbol, and presses down one of the two keys connected with each of them: the electric current then passes along one wire, returns by the other, and turns the two magnets at the remote end of the line. As there are two keys to each wire, and two wires employed for each symbol, two of the keys will make the same two magnets converge *upwards*, and the other two *downwards*. At each end of the line are machines both to communicate and to indicate, that is, to transmit and to receive intelligence; and in order to call the attention of the telegraph officer at the remote station, a separate wire is employed to ring a bell, by transmitting an electric current to a small magnetic arrangement connected with a bell at the remote end. On hearing the bell, the officer looks at a sort of dial or indicator connected with the magnets, and observes the symbols as communicated one by one, and which may succeed each other at the rate of thirty in a minute.

Such were the chief points as detailed to the Committee, with respect to the thirteen miles of wires originally laid down from London to Drayton, and illustrative of the general nature of the operation. But Professor Wheatstone has been actively engaged in improving every part of the apparatus; since the trial on the limited line of railway was rather to test the power of the telegraph than for immediate commercial utility. In successive improvements, secured by patent, but not yet introduced on the railway, Mr. Wheatstone has reduced the number of the wires, simplified both the mode of communicating and that of indicating on a dial the symbol communicated, provided the means for introducing fixed telegraphs at intermediate stations, and portable telegraphs at interval of a quarter of a mile, &c. These experiments have been and are now being carried on along the line of the Great Western Railway; and it is extremely probable that by the time this great undertaking is completed, the telegraphic arrangements will have arrived at a degree of simplification and completeness fully equal to all that has been anticipated from them. This question is of much larger importance than its mere connection with railways. Whoever considers how important an element time is in all the relations of society, will easily see the advantage of communicating intelligence instantl from one end of the kingdom to the other—a feat which we regard as within the bounds of probability. Already attention is being directed to the employment of the electrical telegraph—not only for railway purposes, but for government communications, and also for the conveyance of such private commercial messages as may be comprised in a few words; and a good deal of the evidence given before the Parliamentary Committee had relation to this subject.

We have professed to give merely a summary of the various modes of communication by telegraph, without entering into those minute details which require lengthened description to be well understood. The reader will probably see reason to believe that the time is not very far distant when electrical telegraphs will supersede all others, and distant towns will communicate with a speed literally and truly that of lightning.

Spread of British Manufactures.—I may note a remarkable fact, to show how much we and the Afghans are mutually interested in making the Indus a cheap channel of trade. Syud Keramut Ali, in 1834, got from merchants with whom he was intimate samples of all the manufactured "Russian goods" imported *vid* Bokhara, and which were then selling at the usual good profit in the Cabul bazaar. I lately gave a set of these to a gentleman interested in our trade with the East, when he ascertained from an experienced merchant, to whom they were forwarded, that more than two-thirds of them were of Glasgow and Manchester make.—*Conolly's India.*

*** The Office of the Society for the Diffusion of Useful Knowledge is at 59, Lincoln's Inn Fields.

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